DRAFT AMENDED CLAIMS for Application Number 10/590,409

1. A method for recovering high quality steel and non-ferrous metal products from contaminated molten steel scrap containing dissolved carbon and oxygen by in-line continuous processing of the liquid scrap employing physical desorption into an inert strip gas at reduced pressure under dispersed contact conditions such as that afforded by melt irrigation of a packed bed within a desorption column/tower or desorber with countercurrent gas flow, whilst combating the disruptive effects of sub-surface nucleation and growth of CO bubbles, by recirculation of liquid scrap back into the basal region of the reduced pressure desorber from a liquid metal sump at atmospheric pressure at a rate many times that of the steel product rate and at least in the region of 20 tonnes per minute in conjunction with product metal removal from the liquid sump, which for 500,000 tonnes per annum of steel production equates to about 0.95 tonnes per minute and thereby ensuring operability of the desorber and its associated barometric leg discharge of partially refined liquid scrap into the liquid metal sump at atmospheric pressure, continuity of flow of liquid metal as the dispersed phase within the desorber and the availability of the full diffusional driving forces characteristic of non back-mixed gas/liquid contacting.

2. The method as claimed in Claim 1, wherein the liquid scrap is formed continuously from solid contaminated steel scrap containing up to 1% Zn, up to 0.5% Cu and up to 0.4% Sn and then subsequently refined in a high temperature melt circulation steelmaking circuit, the overall method comprising the steps of:-

(i) preheating the solid scrap in a protective gas atmosphere to separate out in sequence initially a molten zinc and then an aluminum by-product prior to the solid scrap being assimilated into a stream of molten scrap (liquid scrap) within a closed-loop melt circulation system,

(ii) overflowing, withdrawing or siphoning out continuously the liquid scrap at a rate equivalent to the input iron units in the scrap charge into a gas-lift pumping device which feeds the liquid scrap to the top of the first of two reduced pressure packed towers or similar devices, in which the liquid scrap is raised in temperature from near its liquidus temperature to a very much higher temperature typically in the region 1650 to 1780°C by electrical conductive heating or alternatively radiative heat transfer, ensuring the liquid scrap behaves essentially as a quiescent melt under the ambient operating pressure whist being so heated before allowing it to irrigate the solid packing and flow downwards by gravity as rivulets or discrete droplets against an upward flow of strip gas at reduced pressure, which volatilises elemental copper impurity dissolved in the liquid scrap, but only a relatively smaller amount of dissolved elemental tin, whilst itself becoming almost saturated with iron vapour;

(iii) withdrawing continuously via a barometric leg as described in claim 1 the de-copperized liquid scrap containing now less than 0.05% Cu into an atmospheric pressure sump and then into a second gas-lift pumping system employing a lift-gas to which elemental sulphur or gaseous sulphur or sulphur compound gas has been added to the extent that the liquid scrap absorbs sulphur so that greater than the stoichiometric requirement for all the dissolved tin, on average 0.2 – 0.4% Sn, to potentially form stannous sulphide is provided,

(iv) admitting the liquid scrap into the top of a second reduced pressure packed tower or similar device and again using electrical conductive heating, or alternatively by radiative heat transfer to increase the liquid scrap temperature up to typically 1600 – 1780°C prior to contacting the liquid scrap with an inert strip gas so that stannous sulphide is volatilized from the liquid scrap down to at least 0.01% Sn as it flows by gravity through the tower,

(v) withdrawing continuously via a barometric leg as described in claim 1 the now de-tinned and de-copperized liquid scrap into an atmospheric pressure sump, from which the non-ferrous metal depleted liquid scrap is overflown or siphoned continuously into an open-channel melt circulation loop in which liquid steel is forced circulated at a rate many times that of the flow of the refined liquid scrap added to it.

3. The method as outlined in Claim 2 with additional features incorporated if the steel scrap charged to the process contains organic coated steel based on PVC or other sources of chlorine contamination, these features comprising contacting pyrolysis gases evolved during scrap preheating with a spray of liquid aluminium droplets followed then by further contacting in a trickle irrigated packed bed employing a fused salt scrubbing medium containing sodium carbonate as the active ingredient.

4. The method as outlined in Claim 2 with the protective gas atmosphere referred to being preheated by the optional inclusion of a molten aluminium droplet contactor based on molten aluminium both as a heat transfer medium and chemical desiccant, utilizing electromagnetic melt circulation together with the commercially proven mechanical rotor/splash systems developed for the zinc/lead blast furnace.

5. The method as outlined in Claim 2, wherein the exit desorber strip gas in advance of selective condensation of copper and then tin recovery and which is essentially saturated with iron vapour, is first subjected to direct contact iron condensation on recirculated liquid steel close to the liquidus temperature, employing residual unmelted steel shells for melt containment, stabilized by generation of high pressure steam as used for steam turbine power electric power generation by radiation from the outer surfaces of the retained solid steel shell, which surrounds an irrigated packed bed and its associated gas-lift liquid steel melt circulation system.